UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
Resource Assessment and Conservation
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CRUISE RESULTS

Cruise 90-1 Alaska
Cruise 90-1 Ocean Hope 3
Cruise 90-1 Novokotovsk

1990 Eastern Bering Sea Crab and Groundfish Survey

June-August 1990

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish survey of the eastern Bering Sea from June to August 1990. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

A cooperative survey was also conducted aboard a U.S.S.R. research vessel of the Pacific Research Institute of Fisheries and Oceanography (TINRO). During this cooperative survey the Soviet vessel sampled the same area as the U.S. vessels but also extended sampling farther north and west of the U.S.-U.S.S.R. convention line into Soviet waters. This survey will provide the first set of standardized data to study the distribution, abundance, and biological characteristics of groundfish and invertebrates in Soviet waters relative to those in the eastern Bering Sea.

OBJECTIVES

The primary objective of this survey was to provide distribution, abundance, and biological information on crab and groundfish resources in the Bering Sea for:

1. the North Pacific Fishery Management Council,

2. the U.S. fishing industry, and

3. scientific studies of the resources.

Secondary objectives were to:

1. assess the condition of juvenile king crab near Port Heiden and Kvichak Bay,

2. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates,

3. assess spawning yellowfin sole abundance in inshore waters of Togiak Bay and the area near Cape Newenham,

4. evaluate trawl performance and configuration with mensuration equipment,

5. tag Pacific cod and Greenland turbot to provide information for stock movement studies,

6. collect stomach samples for food habit studies,

7. collect and preserve specimens and tissue samples for special studies requests, and

8. conduct comparative trawling experiments between the Alaska and the Soviet research vessel to determine relative trawl efficiencies.

VESSELS AND GEAR

Sampling within the standard survey area was coordinated between two U.S. vessels, the 30.5 m University of Washington Research Vessel Alaska and the 31.4 m commercial fishing vessel Ocean Hope 3, and the 101.6 m Soviet vessel Novokotovsk. Data and samples collected within the standard area aboard the Novokotovsk will be used to supplement those collected aboard the U.S. vessels.

The standard bottom trawl used by the U.S. vessels at all continental shelf stations was an 83-112 eastern trawl. These nets have a 25.3 m (83 ft) headrope and a 34.1 m (112 ft) footrope (Figure 1). They were towed behind 1,000 kg, 1.8 X 2.7 m, steel V-doors and 54.9 m (180.1 ft) paired dandylines. Each lower dandyline had a 0.61 m chain extension connected to the lower wing edge to improve bottom tending characteristics. The 83-112 eastern trawl has been the standard sampling net used during annual eastern Bering Sea surveys since 1982 when it replaced the 400 mesh eastern trawl.

The Novokotovsk used a DT 35/41 Soviet bottom trawl at all standard sampling sites. This net has a 35 m (114.8 ft) headrope and 49 m (160.8 ft) footrope. It was towed behind 1,750 kg round steel doors and 75 m (246.1 ft) dandylines. The Novokotovsk also fished the U.S. 83-112 eastern trawl at selected locations to evaluate differences in efficiency of the two trawls.

Net mensuration systems aboard all vessels were used to provide gear configuration and performance data to be used in area swept calculations.

ITINERARY

The Alaska and Ocean Hope 3 departed Dutch Harbor, Alaska, on June 2 and returned to Dutch Harbor on August 8 upon the completion of the 1990 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Dutch Harbor on June 24 and July 17 to obtain supplies and exchange scientific personnel. Port calls were also made to St. Paul Island on July 21 and August 3 to exchange scientific personnel. A total of 12 vessel days were lost due to weather conditions or equipment failures.

The Novokotovsk departed Kodiak on May 18 for the survey area and began the survey on May 22, approximately 2 weeks earlier than the U.S. vessels. One touch and go was made at St. Paul Island on June 12 to exchange scientific personnel. The Novokotovsk arrived at Dutch Harbor on July 17 to offload equipment and personnel upon the completion of its portion of the survey.

SURVEY DESIGN AND METHODS

The standard survey area sampled by the U.S. vessels is shown in Figure 2. Sampling sites were established on the basis of a 20 x 20 nmi grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations. Stations were also established in the Togiak Bay and Cape Newenham areas where commercial fisheries have operated in recent years to investigate abundance of yellowfin sole. Additional stations northwest of the standard survey area were established to estimate the abundance of Tanner crab (Chionoecetes opilio) in an area that has produced high commercial landings in recent years. Nearshore sites were located near Port Heiden and Kvichak Bay to collect abundance information on juvenile crab and fish. Several days were allocated to intensify sampling efforts at standard station locations where large concentrations of king or Tanner crab were encountered. This additional information will be used to reduce the variability in the crab estimates.

The Alaska and Ocean Hope 3 sampled alternate north/south rows of stations proceeding from Bristol Bay westward to the shelf edge. A tow 30 minutes in duration was made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information, were entered onto diskettes with shipboard computer systems. Size composition and age samples by sex-centimeter category and

other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or frozen. Sea water temperature profiles were collected at most stations using expendable bathythermograph (XBT) probes.

The Novokotovsk sampled alternate rows of stations throughout the standard area later sampled by the U.S. vessels. The Novokotovsk also sampled stations north of the standard area and west into Soviet Union continental shelf waters (Figure 3). This will provide information on the types and magnitude of fisheries resources in Soviet waters, relative to those in U.S. waters. The sampling in Soviet waters will also provide samples and data important to crab studies and to studies of Aleutian Basin pollock, which currently is of great interest and significance. Sampling procedures at each site were adapted from the standard U.S. methodology to provide continuity between the U.S. and U.S.S.R. data collections. The Soviet vessel was equipped with a satellite navigation system; however, because of time lags in signal reception, the accuracy of station locations and distances fished was not always precise. The AFSC, therefore, installed a standard Loran system onboard to provide accurate haul position and distance fished information to be used in area swept calculations.

RESULTS

The Alaska and Ocean Hope 3 successfully completed 370 bottom hauls in the standard area, including a total of 20 special study tows to collect additional information on king and Tanner crab (Figure 2). Twenty tows were also conducted north of the standard sampling area to assess opilio Tanner crab northwest of St. Matthew Island. Seven additional hauls were conducted in the Port Heiden, Kvichak Bay, Togiak, and Kuskokwim areas to assess yellowfin sole concentrations outside the standard area and to collect additional information on juvenile crab.

Biological data collected from fish species aboard the Alaska and Ocean Hope 3 are summarized in Table 1. The two U.S. vessels recorded approximately 144,000 length measurements by sex-centimeter category from the major fish species and about 4,600 age structures were collected and preserved. Individual length-weight data were also recorded for Alaska plaice. About 8,000 stomachs were preserved from various fish taxa for feeding habit analysis. About 50 Pacific cod were tagged and released to provide information on stock movements. Very few viable Greenland turbot were encountered and, subsequently, no specimens were tagged. Red king crab were tagged and released to provide information for growth and movement studies. Numerous whole specimens of various species were preserved for identification, training, and other purposes. Blood samples were collected from approximately 2,000 Tanner crab (Chionocetes bairdi) for

subsequent laboratory examination for the presence of parasitic dinoflagellates. Yellowfin sole maturity data was collected at approximately 30 stations to evaluate spawning regions.

Sea water temperature profiles were collected at most stations using expendable bathythermograph (XBT) probes. Trawl performance and configuration data were recorded at most sampling sites using net mensuration systems aboard both vessels.

The data collected during the Soviet portion of the survey are under review but have not been analyzed and preliminary results are not reported here. In summary, the Novokotovsk completed 345 trawl hauls including 60 comparative sets in which the Soviet trawl and the standard U.S. sampling trawl were fished alternate days to assess the relative fishing power of the two nets (Figure 3). In addition to standard haul, position, and catch information, approximately 65,000 length measurements were recorded from various fish taxa. Blood and various tissue samples were collected from pollock for mitochondrial DNA analysis to evaluate stock structure throughout the Bering Sea continental shelf. Several hundred photographs of individual pollock were taken to be used in morphometric studies at the AFSC. Approximately 550 otoliths were collected and preserved from pollock in U.S. and U.S.S.R. waters to evaluate growth. Several days were scheduled to conduct side-by-side comparative trawling experiments with the Alaska to evaluate relative fishing efficiencies between vessels. Unfortunately, this study was abandoned because of poor weather conditions and limited time.

The total standard survey area encompassed approximately 136,000 nmi^2 and overall catches by the U.S. vessels averaged nearly 373 kg/ha trawled. Catch rates of commercially important fish and crab species taken by the U.S. vessels are shown in Table 2.

Walleye pollock was the most abundant species encountered, with an overall CPUE of about 164 kg/ha trawled. They were taken at nearly all sampling sites, with largest mean catches (350 kg/ha) observed in outer shelf waters at depths of 100-200 m (Figure 4). Mean catches were greatly reduced at depths less than 50 m (10 kg/ha).

Yellowfin sole and rock sole were the most abundant flatfish species, with overall CPUE values of about 34 kg/ha and 27 kg/ha, respectively. Yellowfin sole were primarily restricted to central and inner shelf waters, while rock sole were abundant in the same areas but were more broadly distributed with some concentrations around the Pribilof Islands, in Bristol Bay, and the outer shelf (Figures 5 and 6). Yellowfin sole catches decreased sharply with increased depth, from 100.5 kg/ha in waters less than 50 m to <0.1 kg/ha in waters greater than 100 m. A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod were encountered at nearly all sites sampled (Figure 7). Catch rates varied by depth zone from 4.7 kg/ha trawled at depths less than 50 m to 24.2 kg/ha at depths of 100-200 m, with an overall average of 15.0 kg/ha.

Alaska plaice, flathead sole, arrowtooth flounder, and Pacific halibut had a combined catch rate of 28.6 kg/ha. Alaska plaice and flathead sole were the most abundant species of this group, each having an overall catch rate of 9.3 kg/ha.

Tanner crab (C. opilio) was the most abundant commercially important crab species encountered, with a total average catch rate of 17.9 kg/ha. Red king crab, blue king crab, and Tanner crab (C. bairdi) were caught at rates of 1.1 kg/ha, 0.7 kg/ha, and 3.7 kg/ha, respectively.

SCIENTIFIC PERSONNEL[a]

Alaska

Leg 1	Leg 2	Leg 3
P. Anderson[bc]	A. Shimada[b]	M. Wilson[b]
M. Wilson	M. Yang	C. Armistead
D. Nichol	B. Raschi[d]	K. McGuire
R. Macintosh[c]	P. Cummiskey[c]	F. Hartsock[c]
M. Sloan	B. Dew[c]	B. Otto[c]

Ocean Hope 3

Leg 1	Leg 2	Leg 3
B. Stevens[bc]	G. Walters[b]	T. Sample[b]
D. Fisk	H. Kenny	D. Nichol
C. Armistead	L. Cherepow	K. Strickland
L. Cherepow	J. Parkhurst	G. Lang
B. Pacunski	J. Haaga[c]	R. Macintosh[c]
F. Hartsock[c]	B. Stevens[c]	J. Haaga[c]

Novokotovsk

Leg 1	Leg 2
T. Sample[b]	D. Kessler[b]
B. Benjamin	B. Benjamin
D. Roetcisoender	P. Dawson
P. Dawson	R. Baxter
	J. Bowerman[c]

a Personnel from AFSC, Seattle, unless otherwise noted
b Field Party Chief
c Personnel from AFSC, Kodiak Laboratory
d Personnel from Bucknell University

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Table 1.--Biological data collected by the Alaska and Ocean Hope 3 during the 1990 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures[1/]	Stomach samples	Number tagged
Walleye pollock	34,814	1,358	2,706	--
Pacific cod	5,693	941	1,470	51
Yellowfin sole	32,312	804	1,139	--
Rock sole	32,921	647	613	--
Flathead sole/ Bering flounder	19,383	510	958	--
Pacific halibut	1,819	--	270	--
Alaska Plaice[2/]	7,955	288	393	--
Arrowtooth flounder/ Kamchatka flounder	7,232	--	281	--
Greenland turbot	544	146	27	--
Rex sole	229	--	--	--
Pacific ocean perch	16	--	--	--
Starry flounder	324	--	--	--
Saffron cod	92	--	--	--
Arctic cod	404	--	--	--
Longhead dab	122	--	--	--
Misc. species	21	--	--	--
Total	143,881	4,646	7,857	51

[1/] Scale scrape samples, in addition to otoliths, were collected from Pacific cod. Only otoliths were taken from all other species.

[2/] Individual length-weight data were also collected from Alaska plaice.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the Alaska and Ocean Hope 3 in the standard area during the 1990 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	10.0	114.4	350.4	164.3
Yellowfin sole	100.5	28.6	<0.1	34.4
Rock sole	61.9	28.0	3.6	27.4
Pacific cod	4.7	13.5	24.2	15.0
Alaska plaice	10.8	13.7	1.1	9.3
Flathead sole/ Bering flounder	1.4	7.1	18.3	9.3
Arrowtooth flounder/ Kamchatka flounder	<0.1	4.7	19.8	8.3
Pacific halibut	2.2	1.1	2.5	1.7
Opilio Tanner crab	<0.1	26.1	8.5	17.9
Red king crab	0.7	1.9	0.0	1.1
Bairdi Tanner crab	0.6	5.6	2.6	3.7
Blue king crab	<0.1	1.2	0.2	0.7
Total effort (hectares)	382.5	751.2	403.9	1537.6

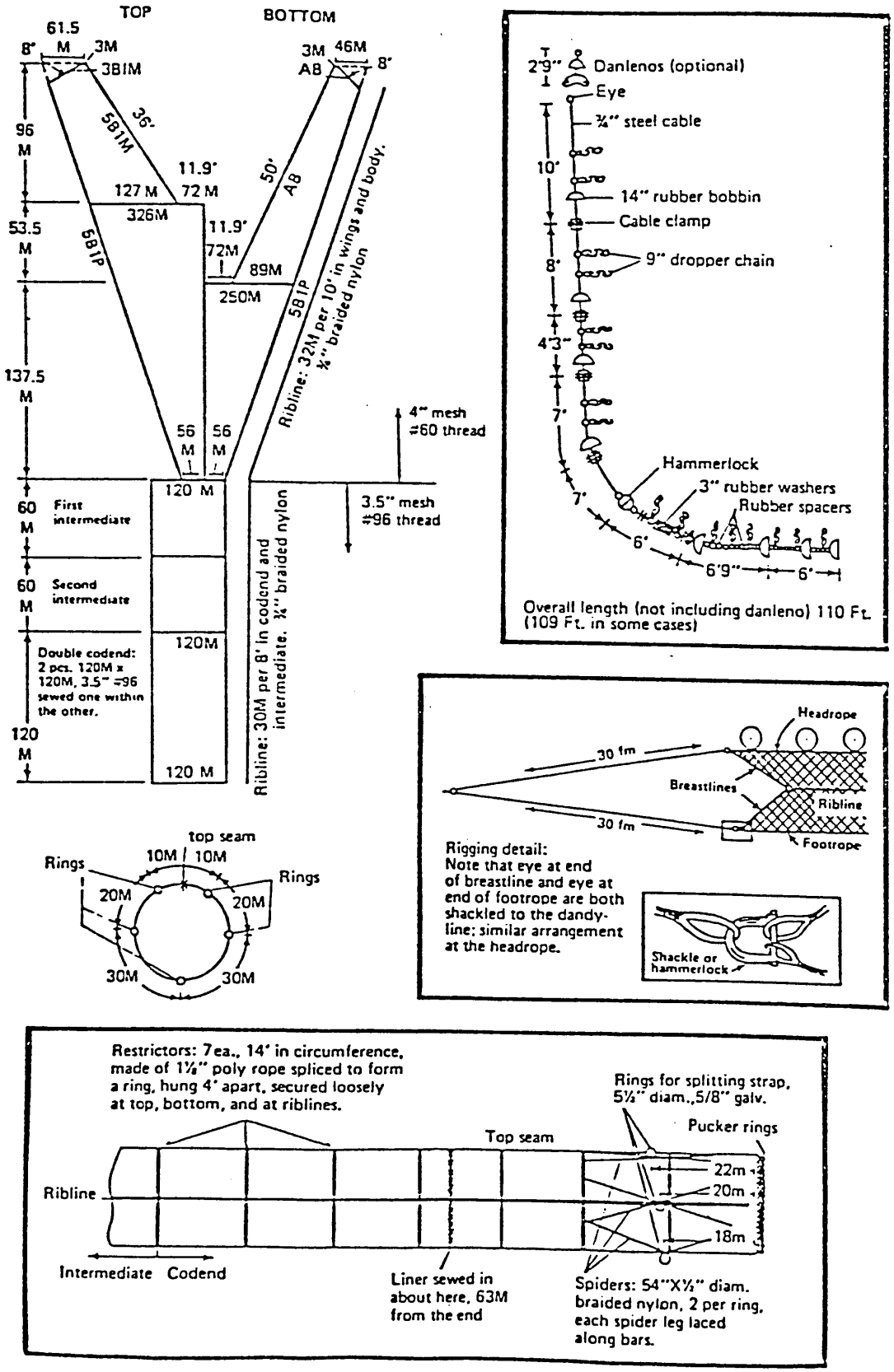

Figure 1.--Diagram of the 83-112 eastern bottom trawl used during the 1990 eastern Bering Sea crab-groundfish survey. The roller gear shown was not used during the survey.

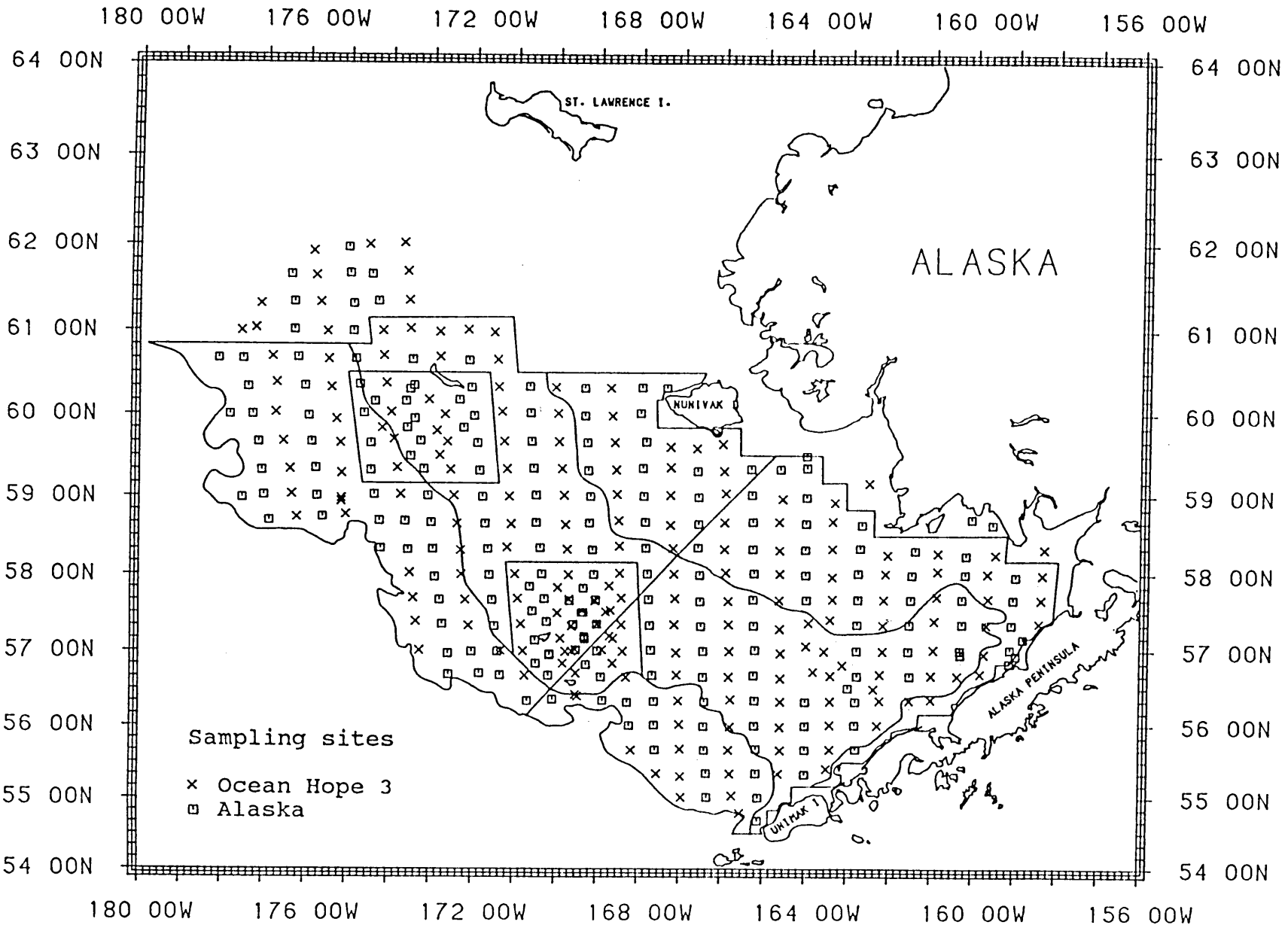

Figure 2.--Distribution of total sampling effort by the Alaska and Ocean Hope 3 during the 1990 eastern Bering Sea survey.

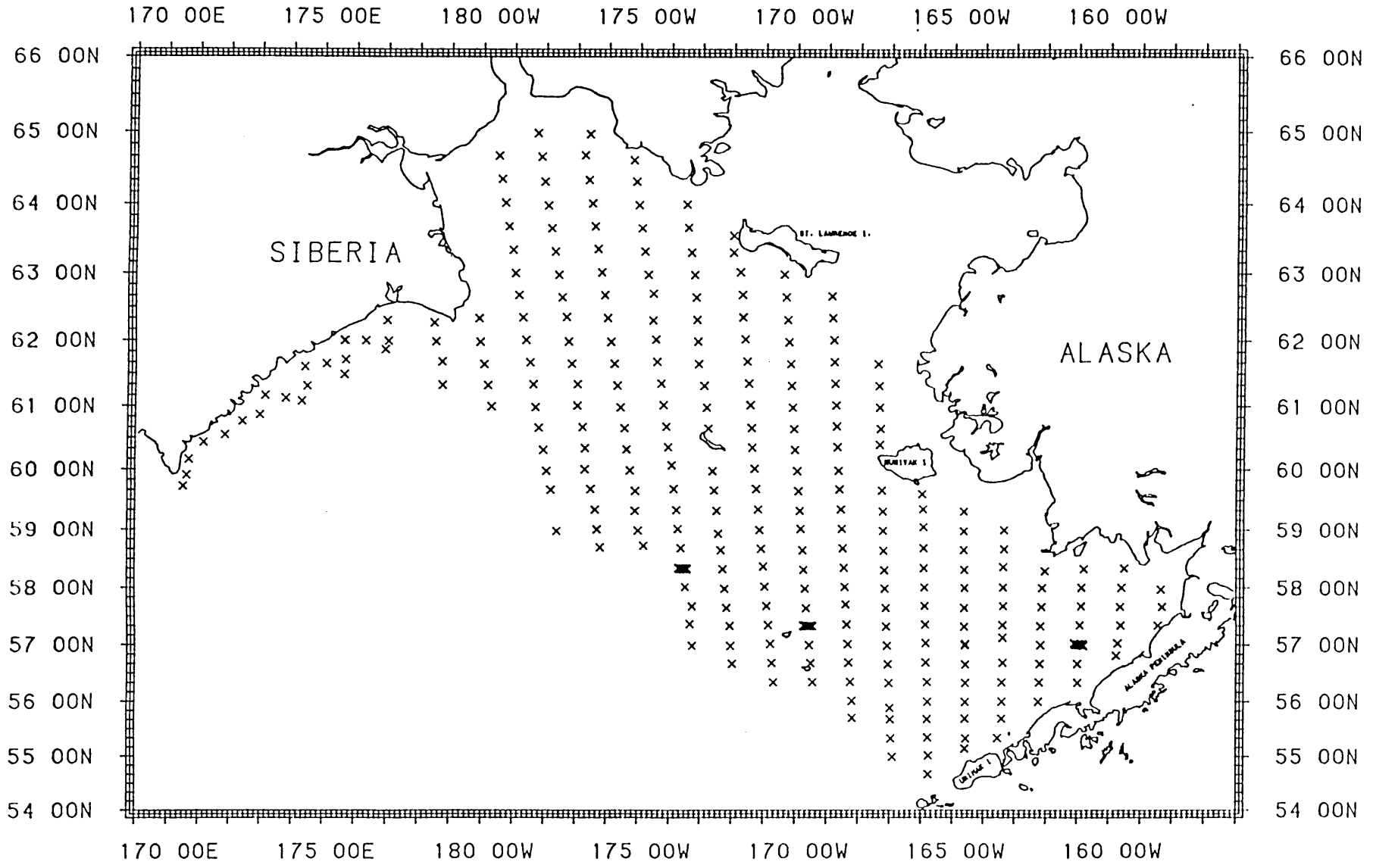

Figure 3.--Distribution of total sampling effort by the Novokotovsk during the 1990 eastern Bering Sea survey. The dense concentration of stations in the southeastern Bering Sea show the locations of comparative trawling using the Soviet and U.S. standard sampling trawls.

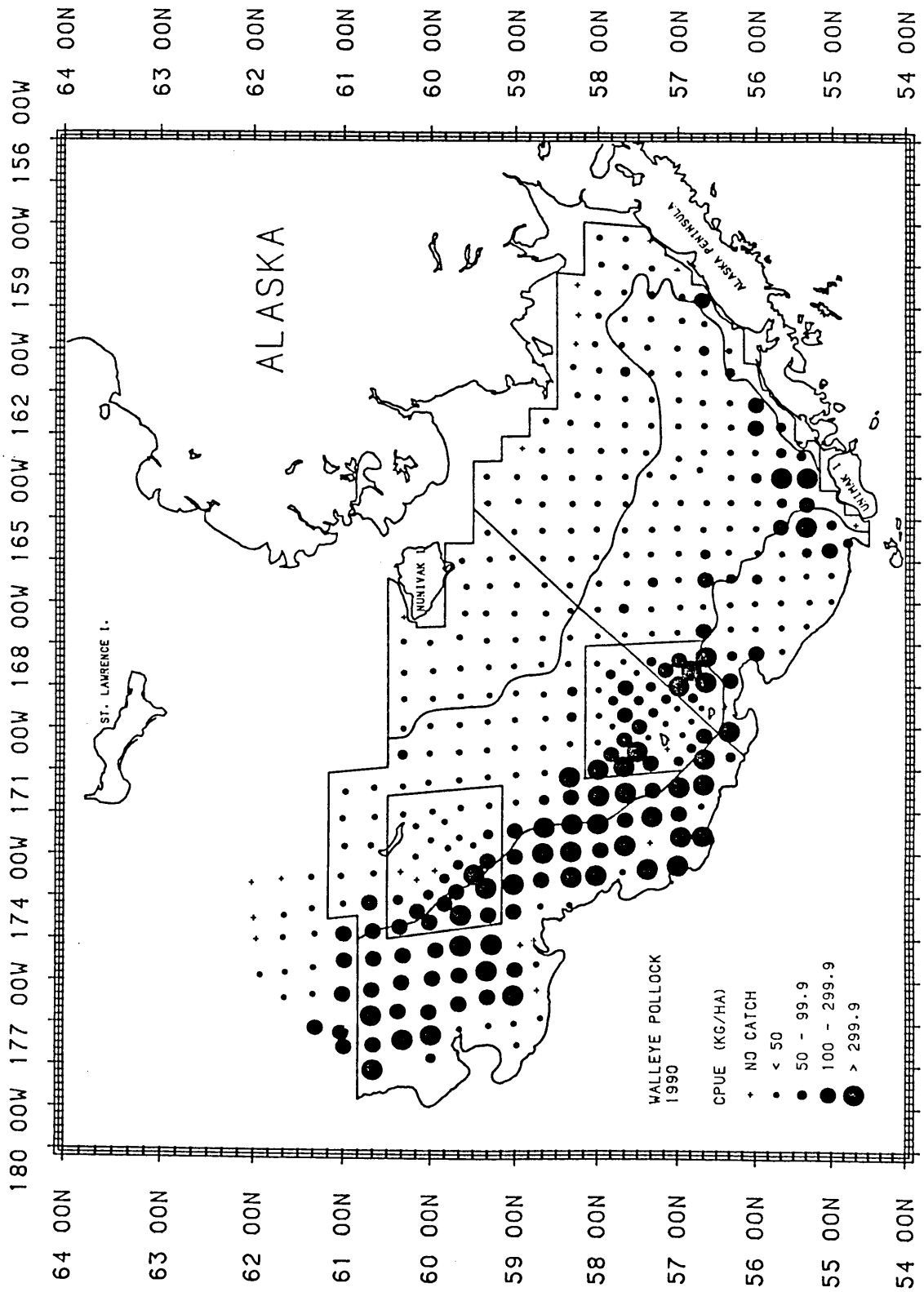

Figure 4.--Distribution of catch rates of walleye pollock from the overall area surveyed by U.S. vessels during the 1990 eastern Bering Sea survey.

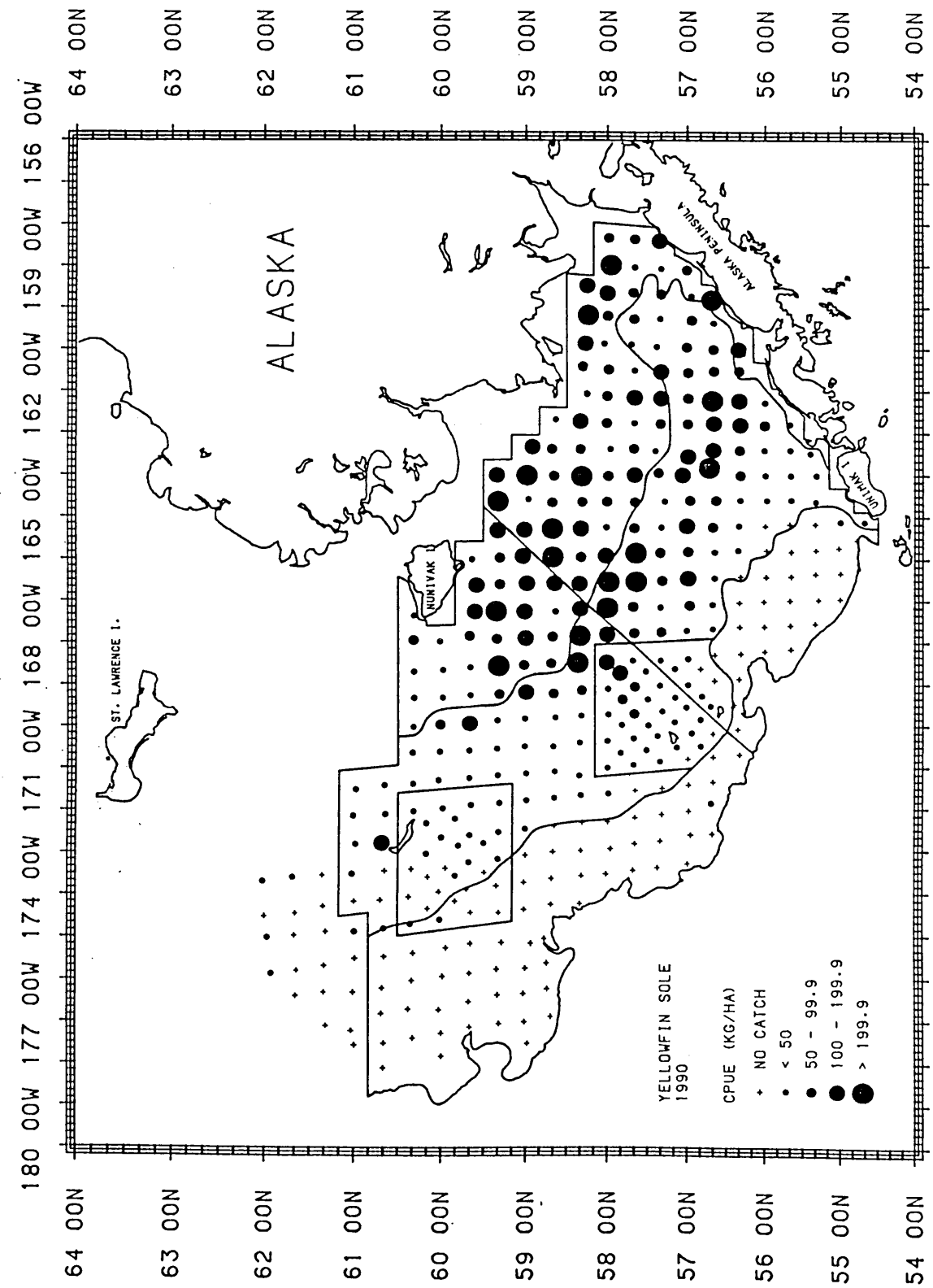

Figure 5.--Distribution of catch rates of yellowfin sole from the overall area surveyed by U.S. vessels during the 1990 eastern Bering Sea survey.

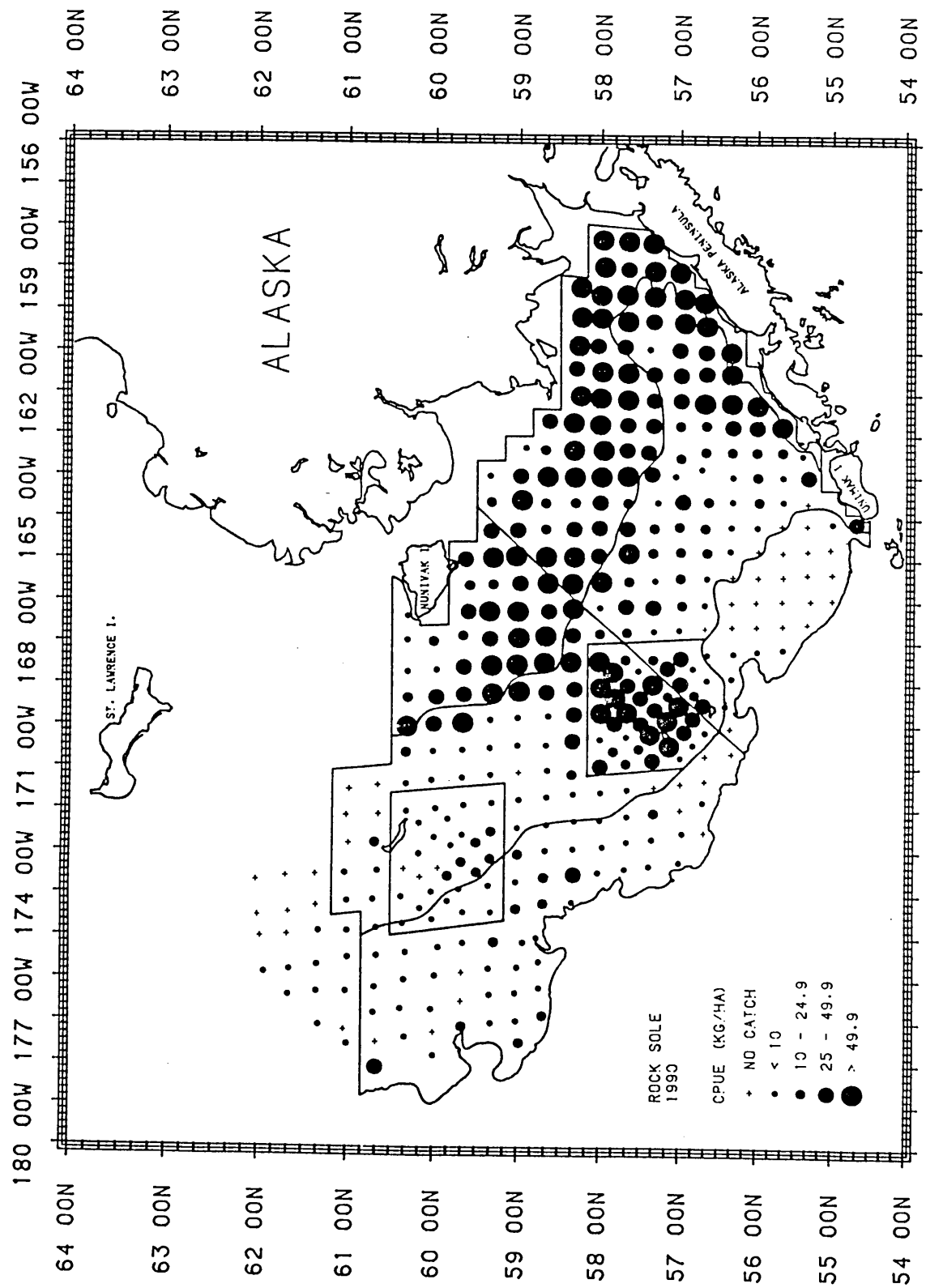

Figure 6.--Distribution of catch rates of rock sole from the overall area surveyed by U.S. vessels during the 1990 eastern Bering Sea survey.

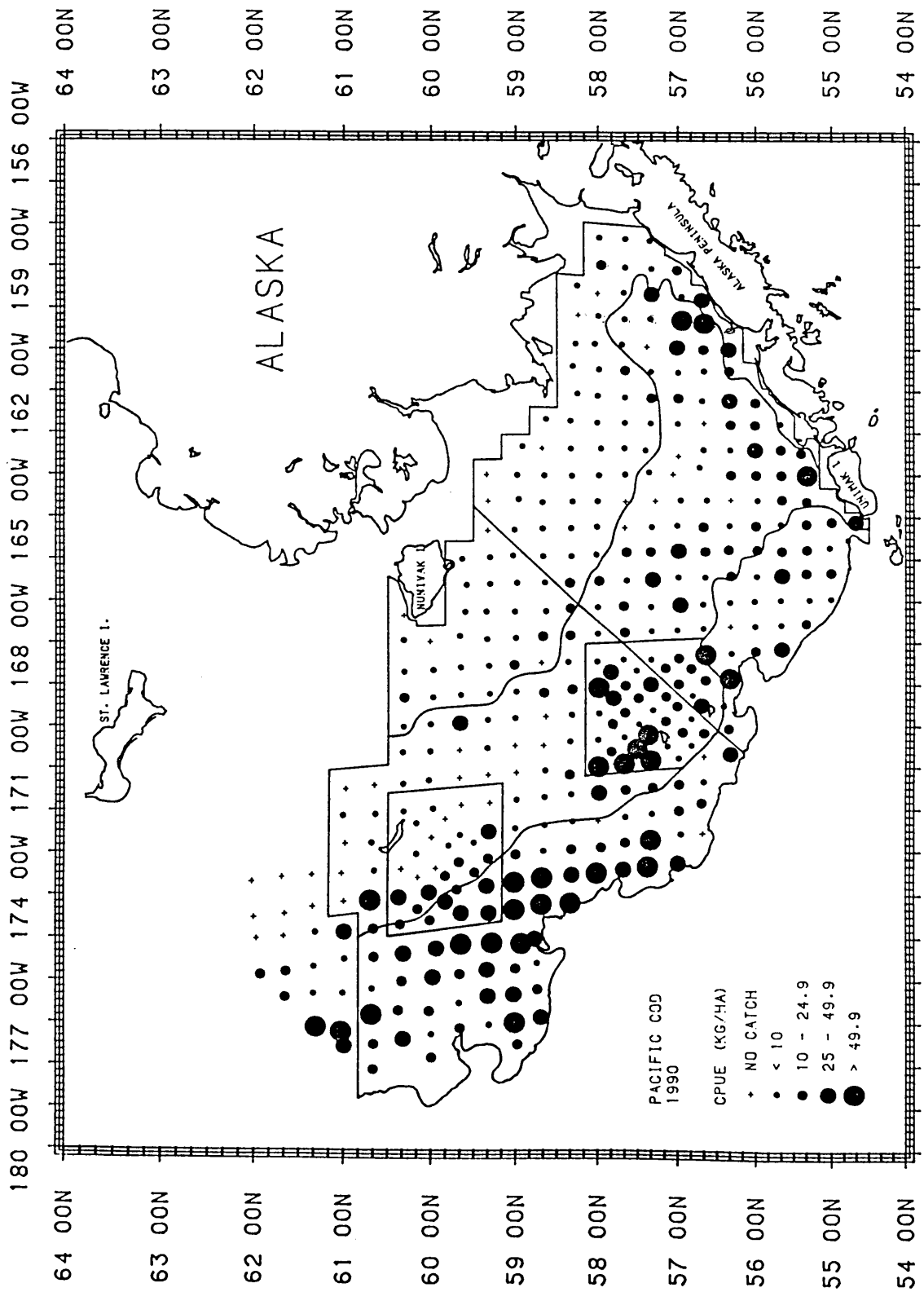

Figure 7.--Distribution of catch rates of Pacific cod from the overall area surveyed by U.S. vessels during the 1990 eastern Bering Sea survey.